V. DROUGHT

A. MONTANA DROUGHT PLAN OVERVIEW

The Drought Advisory Committee (DAC), chaired by the Lieutenant Governor, in 1995, completed the current Montana Drought Response Plan. A unique feature of the current Montana plan is that it recognizes the importance of local actions, and outlines guidelines for the formation of Local Drought Advisory Committees (LDACs). These local committees, based at the county level, are advised to use the same quantitative triggers as the DAC. The triggers are values of the Palmer Drought Severity Index (PDSI), Water Year precipitation, and the Surface Water Supply Index. Montana organizes its state plan into four areas of function or activity: monitoring, reporting, assessment, and response of and to drought impacts.

Title:	The Montana Drought Response Plan
Author/Lead Agency:	Jesse Aber, Planner, Water Resources Division, Department of Natural Resources and Conservation
Year(s) Developed:	1991 – 1993
Current Version:	1995
Primary Impacts Addressed:	Dry land & irrigated crops and livestock, tourism, energy production, domestic and agricultural water supplies, wildfire, and fish and wildlife
Monitoring & Assessment	
Committee Name:	Montana Governor's Drought Advisory Committee
Committee Chair:	Representative of the Governor (Lieutenant Governor 1991-2001)
Frequency/Activation:	At a minimum: on or around the 15th day of the months of March and October. Monthly or more frequently, if required.
Conditions Monitored:	Precipitation, mountain snow pack, stream flow, reservoir levels, and fire conditions, soil moisture, crop conditions
Indices:	Palmer Drought Severity Index (PDSI), Surface Water Supply Index (SWSI), Precipitation monthly and Water Year (Oct. 1 – Sept. 30).
Triggers:	A combination of either the PDSI or the SWSI.
	Palmer -3.0 or less; /SWSI -2.5 or less; Water Year precipitation less than 60 percent & examination of additional data to corroborate indices: "Drought Alert"
	> Palmer less than or equal to -4.0, or SWSI less than or equal to -3.5: "Severe Drought," & examination of additional data to corroborate indices, including Water Year precipitation less than 60 percent.
Response	
Activation:	Once a region of the state reaches the "Alert" status, each agency that is

	a member of the DAC is required to provide a written impact assessment report monthly, along with summary of response(s) to the DAC. The Montana Drought Response Plan identifies specific actions to be taken by state and county or local government at the "Alert" and "Severe" levels.
Task Forces/Agencies:	Dry land Farming - Department of Agriculture Livestock Operations - Department of Livestock Irrigation Water Supplies - Several state and federal agencies Municipal and Domestic Water Systems - Department of Environmental Quality Local drought planning assistance and coordination – DES, Extension, county commissions, conservation districts USDA Program status, communication, coordination - DES Fish and Wildlife - Department of Fish, Wildlife, and Parks Wildfire - Department of Natural Resources and Conservation Public Lands - Several state and federal agencies Energy Production - Several state and federal agencies, PPL Montana Tourism - Department of Commerce Recreation - Several state and federal agencies Secondary Commerce - Department of Commerce
Response	
Activation:	Triggered by the "Drought Alert" and "Severe Drought" stages of the PDSI, SWSI, and measured precipitation.
Task Forces/Agencies:	Each member of the DAC, as well as supporting agencies, are given specific response action responsibilities depending on the current status. Working Group acts as subcommittee – Develops "Action Items."
Supporting Documents	
Montana Drought Response Plan with State Agency Response Summaries and Plan Annexes State Water Plan Section: Drought Management (Dec. 1990) A Guide to Stream Permitting in Montana Policy for Resolution of Water Use Conflicts and Water Rights Enforcement Procedure Federal (USDA) Natural Disaster Determination Drought Statute--Montana Codes Annotated Operations Manual for Local Drought Management Monthly DNRC Water Supply and Moisture Conditions Report Drought Internet sites managed by State Library NRIS	

B. DESCRIPTION

Operational definitions help define the onset, severity and end of droughts. No single operational definition of drought works in all circumstances, and is a big part of why policy makers, resource planners, and others have more difficulty recognizing and planning for drought than for any other natural disaster. Drought must be defined not only in terms of below normal precipitation, but also in terms of duration and cumulative effects. Occasional periods of below average precipitation will not seriously deplete moisture reserves, while prolonged shortages of moisture can deplete moisture reserves enough to seriously affect crops, livestock, forest and rangeland conditions, stream flow, and groundwater as well as hydroelectric, irrigation, and urban water supplies. Ranchers are faced with shortages in grazing capabilities. Due to insufficient grasses created by the drought and the 2000 wildfires, 58% of cattle producers and 48% of sheep producers were feeding with supplemental feeds as early as May 2001.

The effects of drought become apparent with a longer duration because more and more moisture related activities are affected. Agriculture is usually the first economic sector to be affected by drought. Agriculture drought occurs when there isn't enough soil moisture to meet the needs of a particular crop. Non-irrigated croplands are most susceptible to moisture shortages. Rangeland and irrigated agricultural lands do not feel the effects as quickly as the non-irrigated cultivated acreage, but yields can also be greatly reduced due to drought when water supplies are low. Reductions in yields due to moisture shortages are often aggravated by wind- and temperature-induced losses of soil moisture.

Governor Judy Martz, then LT Governor, testified before the National Drought Policy Commission on February 17, 2000. Her testimony stressed the fact that agriculture in Montana accounts for one-third of the economic value in the state. Economic difficulties in agriculture will cause a ripple effect across the economy of the entire state. The Governor's Drought Advisory Committee has established a "Drought Internet Site" at: http://nris.state.mt.us/drought. In addition, the Drought Advisory Committee works closely with Montana's Congressional Delegation and federal agencies to obtain access to federal assistance programs for impacted Montanans once Montana's Drought Response Plan identifies actions for federal, state, and local responses that correspond to the *Drought Alert* and the *Severe Drough*t levels identified by the plan.

The socio-economic impacts of drought occur when water and moisture shortages start to effect people, individually and collectively. Most socioeconomic impacts are associated with the supply and demand of economic commodities. The Montana Agriculture Statistics Service (MASS), with the assistance of the Department of Agriculture and many other agencies, distributed a drought and fires survey in August 2000. This survey indicated that 84% of those Montana citizen's who responded to the survey had suffered losses due to the drought.

In periods of severe drought, forest and range fires can destroy the economic potential of the timber and livestock industries, and wildlife habitat in, and adjacent to, the fire areas. Under extreme drought conditions, lakes, reservoirs, and rivers can be subject to severe water shortages that greatly restrict the use of water supplies. An additional hazard resulting from drought conditions is insect infestation.

The PDSI expresses this comparison of moisture demand to moisture supply on a numerical scale that usually ranges from positive six (+6.0) to negative six (-6.0). Positive values reflect excess moisture supplies while negative values indicate moisture demands in excess of supplies. Table 1 shows how the numerical values are assigned ratings of severity ranging from normal to extreme. The Palmer Index is popular and has been widely used for a variety of applications across the United States. It is most effective measuring impacts sensitive to the soil moisture conditions, such as agriculture (Willeke et al. 1994). It has also been useful as a drought monitoring tool and has been used to trigger or end responses outlined in drought contingency plans (Willeke et al. 1994).

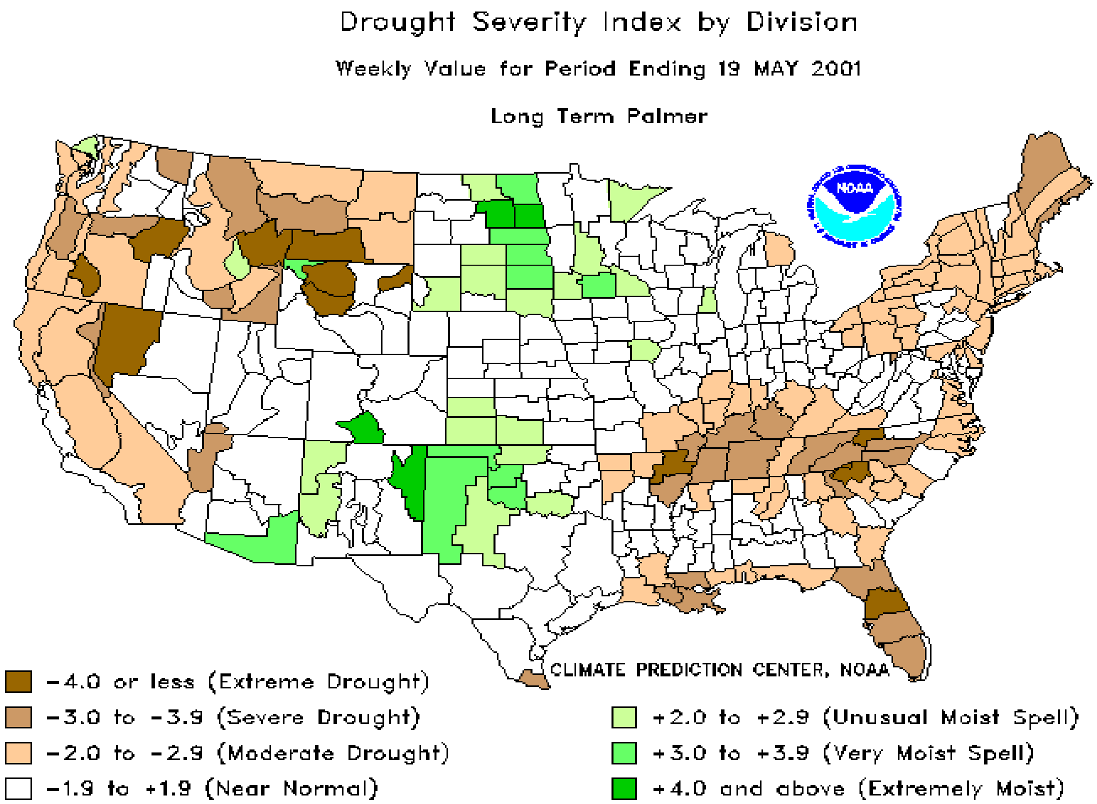
Alley (1984) identified three positive characteristics of the Palmer Index that contribute to its popularity: (1) it provides decision makers with a measurement of the abnormality of recent weather for a region; (2) it provides an opportunity to place current conditions in an historical perspective; and (3) it provides spatial and temporal representations of historical droughts. Several states, including New York, Montana, Colorado, Idaho, Texas and Utah use the Palmer Index as one part of drought monitoring systems.

Table 2: PDSI Classifications for Dry and Wet Periods

4.00 or more	Extremely wet
3.00 to 3.99	Very wet
2.00 to 2.99	Moderately wet
1.00 to 1.99	Slightly wet
0.50 to 0.99	Incipient wet spell
0.49 to –0.49	Near normal
-0.50 to -0.99	Incipient dry spell
-1.00 to -1.99	Mild drought
-2.00 to -2.99	Moderate drought
-3.00 to -3.99	Severe drought
-4.00 or less	Extreme drought

The Joint Agricultural Weather Facility, operated by the National Oceanic and Atmospheric Administration and the United States Department of Agriculture (USDA), calculates the PDSI in the United States. Although originally designed to be used on a monthly basis, the PDSI can be calculated on different time scales to better reflect relatively rapid changes in moisture supplies. Currently, the PDSI figures are published twice monthly in the USDA's Weekly Weather and Crop Bulletin. Both the numerical value and the severity rating are mapped on a region-by-region basis for each state. Figure 1 shows a regional breakdown of Montana's PDSI for May 19, 2001.

Figure 1. Montana's PDSI for May 19, 2001:


Drought Severity Index by Division
Weekly Value for Period Ending 19 MAY 2001
Long Term Palmer
NOAA
CLIMATE PREDICTION CENTER, NOAA
-4.0 or less (Extreme Drought)
-3.0 to -3.9 (Severe Drought)
-2.0 to -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 to +2.9 (Unusual Moist Spell)
+3.0 to +3.9 (Very Moist Spell)
+4.0 and above (Extremely Moist)

C. HISTORICAL OCCURRENCE AND RESPONSE

The 1930's Dust Bowl remains the most highly publicized of past droughts in Montana, but a brief survey of the last 30 years of drought related articles in the Great Falls Tribune shows that the "Dirty Thirties" were by no means the last, or perhaps the worst, drought seen in this state.

The mid-1950s saw Montana with a period of reduced rainfall in the eastern and central portions of the state. In July of 1956, four counties applied for federal disaster aid due to greatly reduced precipitation amounts since June of the previous year. By November of 1956, a total of twenty Montana counties had applied for federal drought assistance.

Montana found itself in another drought episode in 1961. By the end of June, 17 counties had requested designation as federal disaster areas due to lack of moisture, higher than normal temperatures, and grasshopper infestation. Small grain crops died before maturing, and range grass and dry land hay crops were deteriorating rapidly. Livestock water supplies were at critical levels. In July of 1961, the State's Crop and Livestock Reporting Service called it the worst drought since the 1930's. Better conservation practices such as strip cropping were helping to lessen the impacts of the worst water shortages since the 1934-36 years.

By August of 1961, 24 counties had applied for federal drought disaster aid. The state was eventually awarded $420,000 under a federal cost-sharing program where funds were to be used for digging wells, building fire guards, conserving irrigation water, and implementation of wind erosion protection practices.

Five years later in 1966, the entire state was experiencing yet another episode of drought. Although water shortages were not as great as in 1961, a study of ten weather recording stations across Montana showed all had recorded below normal precipitation amounts for a ten-month period. By August of 1966, the Bitterroot Valley was experiencing its worst drought in 25 years, and the state arranged to sell water to local irrigators.

A seven-month survey ending in May of 1977, estimated that over 250,000 acres of Montana farmland had been damaged by winds. Inadequate crop cover and excessive tillage practices had resulted in exaggerated soil damage due to inadequate soil moisture supplies. This drought episode was most severe in the western and south-central parts of the state.

Water supplies were so critical by June of 1977, that officials from Montana were working with others from Idaho, Washington, and Oregon on the Northwest Utility Coordinating Committee in an attempt to moderate potential hydroelectricity shortages. On June 23, Governor Judge issued an energy supply alert and ordered a mandatory ten percent reduction in electricity use by state and local governments.

Eastern Montana found itself with another well-established drought episode in 1980. The southeast corner of the state had received less than four inches of precipitation since July of 1979. In the northeast corner of the state, Glasgow received only 4.74 inches in the period from June of 1979 to May of 1980, making it the driest 12-month period on record since 1905. Grasshopper infestations were seen in isolated areas, little wheat was planted, and large numbers of livestock were being sold due to the hay and water shortages.

By October, estimates of 1980 federal disaster payments were five times those paid in 1979. In Richland County alone, 600 of the county's 800 farmers had applied for federal payments. Total drought related economic losses for Montana in 1980 were estimated to be $380 million.

The drought that had started in 1979 continued into 1981. March snow pack was at 50-60 percent of normal, initiating forecasts of critical water shortages later in the season. All areas east of a north-south line running from Havre through Billings had received less than their normal precipitation in the first three months of 1981. Wolf Point had received only six inches since June of 1979. Fortunately, large May storms brought moisture to much of the state, but then flooding started to occur in the formerly parched areas. The northeast corner of the state, where 40 percent of Montana's wheat crop is produced, remained the driest area of the state, despite the spring storms.

Inadequate moisture supplies were again the problem in 1984. By July, many of the Hi-Line cities were experiencing water shortages and rationing schedules were put into effect. Conrad businesses voluntarily closed to help curtail water use. The seven districts involved in the Milk River Irrigation Project were out of water, and crop losses were estimated at $12-15 million. August of 1984 saw Montana in flames with numerous forest and range fires burning out of control.

Drought continued to plague the state in 1985. All 56 counties received disaster declarations for drought during this year. April estimates by the Montana Crop and Livestock Reporting Service put the state's pasture and range at 65 percent of normal, while conditions in the northeast corner of the state were down to 32 percent of normal. From 1982 through 1985 approximately one-third reduced cattle herds.

The continued lack of moisture in 1985 resulted in a wheat crop that was the smallest in 45 years. Grain farmers received more in government "deficiency payments" and insurance money than they did for their crops. For a "typical" 2500 acre Montana farm/ranch, the operator lost more than $100,000 in equity (collateral, borrowing power) over the course of that year. The state's agriculture industry lost nearly $3 billion in equity.

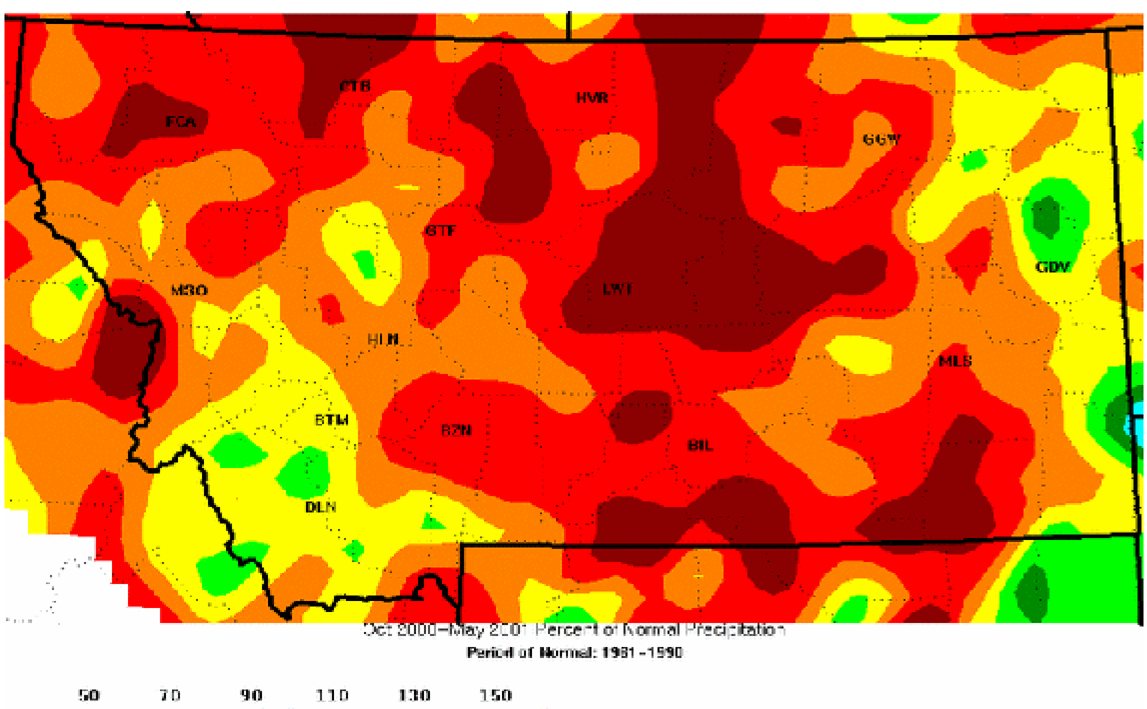
The extended effects of this drought included the loss of thousands of off-farm jobs, the closing of many implement dealerships and Production Credit Associations (Gilles, 1985).

Currently, Montana is experiencing its third year (1999, 2000, 2001) of drought. In the years 2000 and 2001, all 56 Montana counties received a National Disaster Determination (NDD) from the U.S. Department of Agriculture. In May, Governor Martz requested and was granted an extension of the 2000 statewide NDD for the year 2001.

Agriculture is a mainstay for Montana's economy. Drought conditions can critically affect the viability of this economic sector and create lifestyle-altering conditions for our agriculture producers. With low market prices for dryland farming commodities, and little water for livestock, many Montana grain and livestock growers are facing economic failure and loss of fourth and fifth generation family-owned farms and ranches.

D. PREDICTION POTENTIAL FOR RECURRENCE

Droughts are most often predicted only after they are already underway. The National Weather Service issues seasonal forecasts for expected precipitation amounts, but these long-term forecasts are somewhat limited in their accuracy, and should not be taken as the final word on next season's drought conditions. They can serve as warning signals to be aware of other drought warning signs that can be watched and used as guidelines in water related management programs.



Establishment of a "normal" or "average" amount of precipitation is very dependent on what span of time is chosen. Normal precipitation amounts used in the USDA's monthly publication of climatological data are 30-year averages that are adjusted every ten years. In a relative sense, these averages are useful. The biggest problems come when these normals are used to predict how much precipitation should be expected. The highly variable nature of Montana's climate means that very few years in a given time period can be considered "average." For example, precipitation totals for very few years would fall within 10 percentage points, plus or minus, of the average precipitation figure. In a relative sense, a farmer in eastern Montana should expect to receive about as much precipitation as last year. At the same time, he or she should not be surprised if what precipitation in fact occurs, turns out to be what the average was for a given period of time 30 or more, years ago. Using the data available for Glasgow, Great Falls, and Miles City since 1897, the following results are obtained:

Station	Average Precipitation	Standard Deviation
Glasgow	12.5 inches	3.9
Great Falls	15.1 inches	3.9
Miles City	13.5 inches	3.6

The standard deviation means that, statistically, Glasgow residents can expect that for two-thirds of any given period of time their annual precipitation will be between 16.4 inches and 8.6 inches. This type of variability in precipitation is especially important in semi-arid climates like that of eastern Montana. Where total amounts tend to be less than 15 inches per year, a small amount of variability can constitute a large percentage of the total. There are also warning signs available for shortages of water reserves other than soil moisture. The Soil Conservation Service provides snow survey data for Montana throughout the winter and spring snow seasons. Montana's snow pack provides almost 70 percent of spring and summer stream flow throughout the state.

If seasonal snow pack is below 60 percent of normal, then it can be expected that stream flow will be less than half of what normally occurs during the spring and summer months. These types of projections are essential in managing irrigation and hydroelectric projects throughout the state, and are vital in fish, wildlife, and other recreational management. The mountainous areas of western Montana receive higher levels of precipitation, and therefore are not as susceptible to variability in annual precipitation. This does not, unfortunately, make the western regions any less susceptible to large-scale droughts.

Analyzing the causes of drought is another means considered in predicting recurrence. Long-term weather patterns, such as droughts, are the result of complex global weather patterns. Due to this complexity, climatologists and meteorologists still do not agree on exactly what causes drought. Part of the complexity has to do with the long-term cycles involved in shaping the global weather picture. Shorter cycles are often superimposed over longer term cycles, making the global picture even more unclear.

Climatologists have studied droughts to try to determine if any recognizable cyclical pattern emerges. The most convincing pattern to be seen so far is an 11- and

22-year recurrence that corresponds to sunspots cycles. This pattern has gained support because solar energy is the major driving force behind global atmospheric circulation, and sunspot cycles do reflect fluctuations in the amount of solar energy the Earth and its upper atmosphere receive. The biggest problem climatologists have in accepting the drought-sun spot cycle is the length of available records. Many feel that available records are not long enough to make the drought-sun spot cycles statistically significant. A statistical analysis of Miles City precipitation data from 1897 to 1984 does show a definite 22-25 year cycle of drought recurrence, with a much weaker trend seen every two to three years.

The problem of relying on short-term precipitation averages and the difficulty of establishing proof of recurring drought cycles both point out the importance of finding some long-term records of past climates. Tree-ring study techniques are becoming more sophisticated, and therefore more useful in the analysis of past climatic conditions. Trees can live for generations, and record yearly weather conditions in their growth rings. Tree ring analysis can extend weather records well into the past. This is especially important in a state like Montana where weather records are limited because it has been settled for a relatively short period of time.

Long-term records are essential in establishing patterns of drought occurrence. Whether or not a regular cycle can be established for drought recurrence in Montana, an established record of occurrence helps to show that drought is something to be expected. Long-term records can also be important in establishing the severity of drought to be expected. Both the recurrence intervals and the severity are important aspects of any type of long-term plan to help mitigate the effects of drought on Montana.

E. STATE VULNERABILITY TO DROUGHT

Since Montana's population and water usage is continuing to grow, demand for water is rising at a steady rate. Available supplies have also increased over the years through a variety of structural (dams) and non-structural (conservation) means, but the State's ability to create new levels of supply is marginal. In recent years, demands on water have been increasing faster than supplies, so that tolerance to deal with water shortages is diminishing. The balance between supply and demand is likely to be disrupted more and more frequently, and in the future, water shortages are likely to be more frequent and costly.

It is difficult to assess Montana's overall vulnerability to drought since it affects all levels of water use. However, the effects of water shortages are seldom disastrous in most sectors. For example, drought may have an economic impact on water-based recreation, but the effect could hardly be considered a disaster. Similarly, drought seldom has a disastrous effect on municipal water supplies with the exception of a few areas of the state where systems have experienced historical water depletion problems. According to the Department of Environmental Quality, municipal water shortages are most often the result of overuse. Often, people anxiously anticipating predicted drought episodes tend to use more water, exacerbating an already precarious situation. Those localities with a history of drought-induced depletion problems may expect future shortages and should place emphasis on mitigation strategies (e.g., ration groundwater use since it is a more reliable source) (Fraser, 1986).

As revealed earlier in this section, agricultural users feel the most significant impacts of drought. And in any given year, one or more parts of Montana are likely to experience drought conditions. During the 2000 growing season, more than five-sixths of the state received below normal amounts of precipitation (National Weather Service 2000). Nevertheless, the northeast area of the state received well-above normal amounts of growing season precipitation in 2000. Should drought intensify to the point where broad scale impacts exceed state and local response capabilities, the state program for the mitigation of drought impacts would facilitate a request for federal assistance (Montana Disaster and Emergency Services Division, 2000).

F. MITIGATION

With the realization that drought is an inevitable part of life in Montana, the important issue is, what can be done to lessen its effects? Since it is a difficult phenomenon to predict ahead of time, the best approach to mitigation is implementation of year around water conservation practices.

As mentioned earlier in the historical summary of Montana's droughts, agricultural practices have improved through the years so that the adverse effects of severe moisture shortages have been reduced somewhat. Because soil moisture is an important moisture reserve, soil conservation programs are also water conservation program

In connection with the PDSI, calculations can be made to determine the amount of precipitation needed to bring the moisture balance to near normal. These figures are available during the growing season, along with the bi-monthly PDSI, in the USDA's Weekly Weather and Crop Bulletin. These figures could be useful in determining if a drought episode is severe enough to make planting of non-irrigated grains impractical. If the precipitation deficits are beyond reasonable seasonal amounts, chances are good that small grains planted would not provide economic yields

In good moisture years, it is more difficult for farmers and ranchers to see the benefits of conservation practices because soil moisture is not always an asset reported on economic statements

Once the water is into the rivers, lakes, and reservoirs, its conservation becomes the responsibility of those drawing from those reserves. Water conservation at the residential, commercial, municipal and industrial levels should focus on management of both supply and demand. Supply management programs may consist of metering, leak detection and repair, pressure reduction, watershed management and evaporation suppression. Demand management programs may include pricing, regulation, and conservation education. Further information on those programs is available in "Before the Well Runs Dry, a Handbook for Designing a Local Water Conservation Plan" (see literature cited).

Like farmers and ranchers, other users can only be expected to manage wisely if they are well informed about the resource with which they are dealing. Adequate information on snow pack and available soil moisture is essential to these people. Again, some method of educating water managers in drought mitigation techniques is highly advisable.

Augmenting natural precipitation is another option available for lessening the effects of drought. Although not in widespread use at the present time, it is not a practice that should be ignored in the future. As technology improves, cloud seeding is becoming better understood, enabling its practice to become more effective.

The *monitoring* function involves state and federal agencies that are mandated to employ a number of technologies in the collection and continual monitoring of water supply and moisture conditions. Information is also sought from drought committee members representing organizations from various economic and resource sectors such as livestock, water users, recreation, and farming. *Reporting* requires the timely sharing and dissemination of collected information to the Governor's Drought Advisory Committee and the media to ensure visibility and public awareness of the impacts expected from drought so those potentially affected have an opportunity to plan accordingly and mitigate a portion of the potential loss to the economy and to natural resources.

Assessment occurs on a number of resource, geographic, and governmental levels and involves using appropriate sources of current information about expected impacts, and providing for the delineation of problem area needs to determine the potential for an actions to forward impact mitigation. As needs are assessed, *response* consists of any action taken by committee state member agencies, units of local government, and individuals to address those needs.

Further research and policy development is needed to enhance future drought planning efforts in the following areas:

- Dissemination of drought information to the public.
- Solicitation of local government and private sector assistance during drought episodes.
- Ensuring that disaster assistance programs get relief to those for whom it is intended.
- Other state drought mitigation strategies.
- Statutory options for increasing the emergency powers of the Governor during drought situations.
- Efficient water use techniques and programs.
- Drought probability and climate anomaly studies.
- Short and long-term secondary drought effects - both economic and environmental.

G. SUMMARY

Drought is a special type of disaster because its onset is difficult to identify or discern, it affects people in the same area in different ways, and its occurrence does not require evacuation of an area nor does it constitute an immediate threat to life or property. People are not suddenly rendered homeless or without food and clothing. The basic effect of a drought is economic hardship, but it does, in the end, resemble other types of disasters in that victims can be deprived of their livelihoods and communities can suffer economic decline.

At least 50 percent of the state's electricity comes from hydroelectric generators. Over one million acres under irrigation are harvested each year. Dryland farming and ranching continue to contribute a large percentage to the state's agricultural production. Forestry and outdoor recreation supports a significant segment of the population. Recreation not only brings in out-of-state dollars, but is a very important part of life to Montanans as well. All of these functions require adequate supplies of water.

Meteorologists and climatologists have established that droughts are a natural part of the global climatic cycle, and that it is not unusual for them to be severe and prolonged in semi-arid areas like Montana. The improper use and management of water and related resources such as soils and forests can aggravate the severity of drought impacts. People using natural resources in Montana must have adequate information available to them in order to make wise management decisions.

H. RECOMMENDATIONS

- **Improved agriculture practices**: Leaving stubble as mulch on fields in the fall catches and holds more moisture in the form of snow, and also keeps soil from being blown away. Strip cropping helps to reduce wind erosion during the growing season while providing a more efficient use of soil moisture than straight fallow in areas prone to saline seep. Planting shelter belts also serves as a means to reduce erosion. Grain varieties not usually planted in years of good precipitation, due to their relatively low yields, might be considered because of their ability to maintain adequate yields under low moisture conditions. If moisture deficits are beyond reasonable expectations, below normal yields could be expected from non-irrigated hay acres, and reductions in livestock herds could be considered. Such examples of management decisions associated with soil moisture reserves in Montana are numerous

- **Improved forest management**: Wise forest management is also important in mitigating the effects of drought. For example, conservative lumbering practices will ensure an adequate supply of trees on the slopes to catch and hold the snow pack through the critical seasons. Renegotiation of logged areas is important for the same reasons. Management in these watershed areas directly affects the amount and quality of water that enters into Montana's rivers and streams, and subsequently its lakes and reservoirs.

- **Planning**: One of the most effective drought mitigation techniques is planning. In 1991, the Montana Legislature passed drought legislation that established the Montana Governor's Drought Advisory Committee and defined its membership and responsibilities. Over the following two years, the Montana Drought Response Plan was developed. The purpose of this plan is to provide an effective and systematic means for the State of Montana to deal with drought problems that may occur over the short or long term. Briefly, the plan defines and outlines actions classified in four basic activities: Monitoring, Reporting, Assessment, and Response, all of which continue year around.

- **Public Information**: A public information program about the drought hazard in Montana is the best way to ensure good water management in the agricultural sector.

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